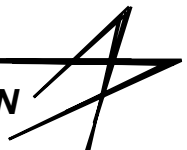


Alpha Magnetic Spectrometer - 02
(AMS-02)
Critical Design Review

Operations Overview

Prepared By: P. Nemeth



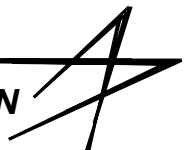
Contents

- Prelaunch
- Ascent
- On-Orbit
 - Space transportation System (STS)
 - International Space Station (ISS)
- AMS Crew Operations Post (ACOP)
- EVA Interface



Kennedy Space Center Flow

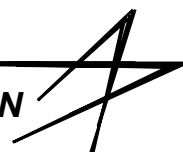
- Arrive at Multi-Purpose Payload Facility (MPPF)
- Integrate AMS
- Top-off Cryo
- Power up/checkout Avionics and Charge Magnet
- Discharge Magnet and Power off all systems
- Package and transport to Space Station Processing Facility (SSPF)
- Integrated Verification Test in LPIS and PRCU
- Power up/checkout avionics, No Magnet Charge planned at this time
- End to End Test in STS



Prelaunch Operations Profile

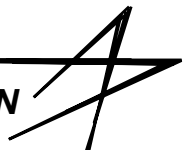
- T₀ Umbilical requirements
 - Vent Pump, Cryocoolers, Cryo valves, Main Control Computer (MCC)
 - 120Vdc Power, command, and telemetry
 - Commanding includes vacuum pump and cryocoolers on/off and momentary power for cryo valves open/closed
 - Telemetry includes temperature/pressure measurements and system operating characteristics).
 - 1553 for command/telemetry requirements
 - All Power routed through the Power Distribution Box (PDB) except for Vent Pump
 - Required continuously until T-9 min to monitor health status of Cryo systems (Vacuum case pressure and SFHe pressure/temp)
 - Remainder of experiment avionics
 - High Rate Data via RS422
 - Required only for calibration and contingency troubleshooting operations

LOCKHEED MARTIN
Space Operations



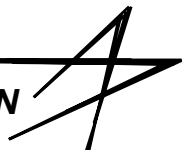
Prelaunch Operations Timeline

- Installation through L-30 min nominal ops
 - 650 W for MCC, Cryo valves, Cryo coolers, SFHe Tank vent pump
 - Maximum of 2 kW for calibration and contingency should be completed prior to L-TBD days
- At L-30 minutes
 - Close SFHe Tank Vent and deactivate pump
 - Deactivate Cryo coolers
 - Power down all equipment with the exception of MCC and necessary CAB functions to monitor of cryo system health (limited to 120W)
- Monitor health status of cryo systems till T-9 min
- Launch, T0 disconnect (loss of 1553/power)



Ascent Operations Requirements

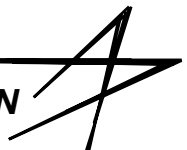
- SFHe Tank Nominal Vent Valve operation
 - Barometric switch to open valve when PLB pressure is less than the SFHe
 - Time-tagged command via Backup Flight System (BFS) General Purpose Computer (GPC) to open as backup @ L+ TBD min
 - 28Vdc momentary power for valve opening and 5Vdc discrete for command
 - In the event of an abort must close vent valve when descending through 100,000 ft ($\pm 20,000$ ft)
 - Any potential ignition sources will be compliant with NS2/81-M082



On-Orbit STS Operations Profile

- Activate Assembly Power Converter Unit (APCU)s, Cryocoolers, and Housekeeping data at approximately Mission Elapsed Time (MET) 2 hr 30 min
- Activate/checkout AMS avionics subsystems and thermally condition payload
- Maximum power draw on shuttle 2 kW @ 120Vdc
- No magnet charging on STS
- Dock with ISS (MET Day 3)
- Power down AMS prior to transfer operations, transfer to ISS by MET day 4.
- Grapple Flight Releasable Grapple Fixture (FRGF) with Shuttle Remote Manipulator System (SRMS)
- Disconnect Remotely Operated Electrical Umbilical (ROEU)
- AMS removed from PLB by SRMS

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Space Operations

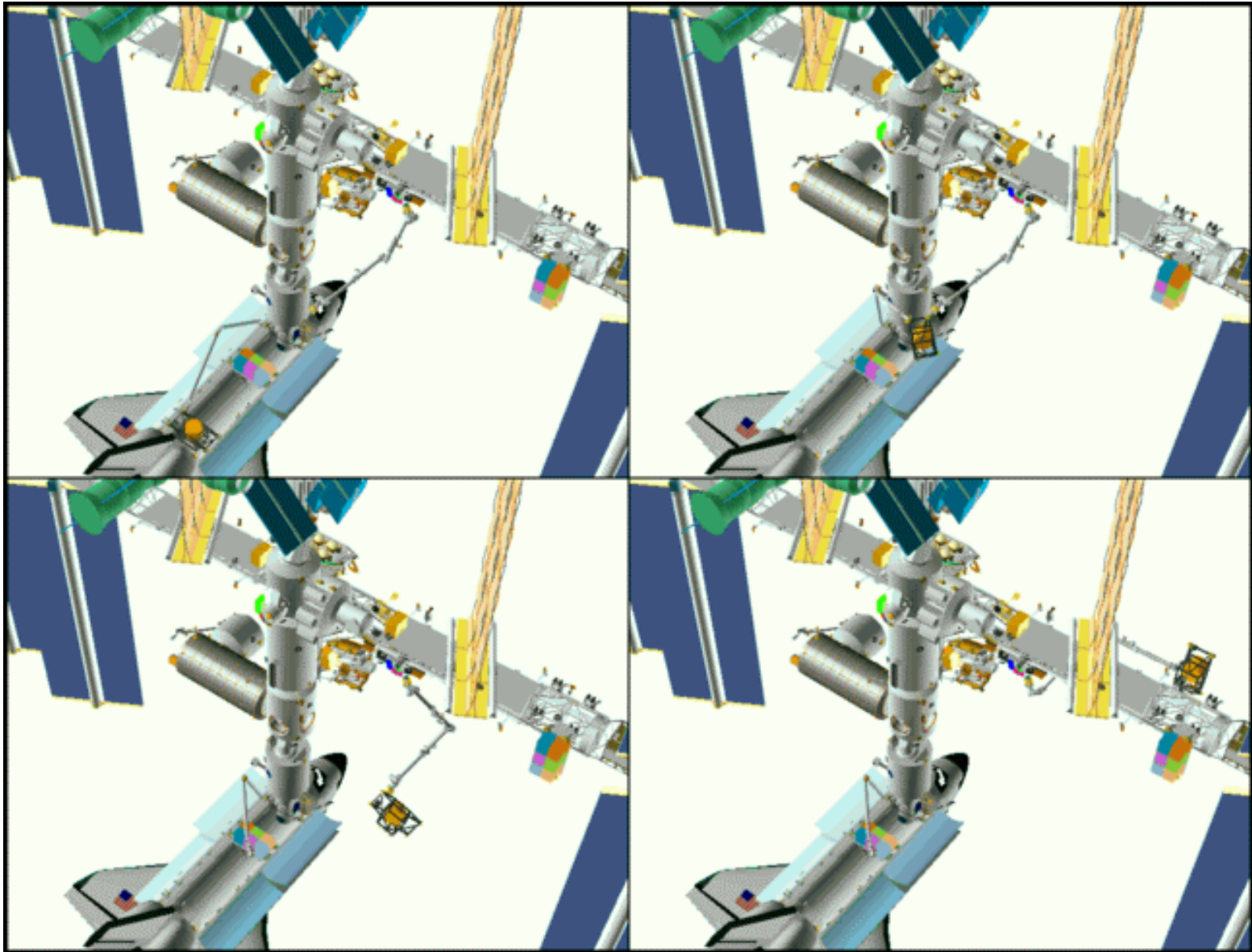


On-Orbit ISS Operations Profile

- Power up ACOP
 - Note: ACOP must be checked-out and active prior to AMS installation on ISS. (Transferred to ISS on previous flight.)
- Grapple Power and Video Grapple Fixture (PVGF) with Space Station RMS
 - Note: Supplies power to and video signal from Berthing Cues System located on AMS
- SRMS release of AMS
- Transfer to S3 attach site
 - Berthing Cues System (BCS) utilized to verify final approach to Attach Site
- Attach AMS to S3 upper inboard site mechanical/electrical (via PAS & UMA)

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Space Operations



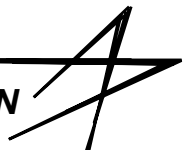


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Space Operations



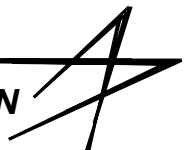
On-Orbit ISS Operations Profile (Cont.)

- SSRMS Ungrapple
- Power up Avionics
- Perform abbreviated avionics checkout
- Begin magnet charging operations (w/ crew monitoring)
- Once Magnet charging operation complete, begin 3 years of science data acquisition.
- Primary control of AMS is from ground.
- Crew interfaces to AMS include ACOP and Portable Computer System (PCS).

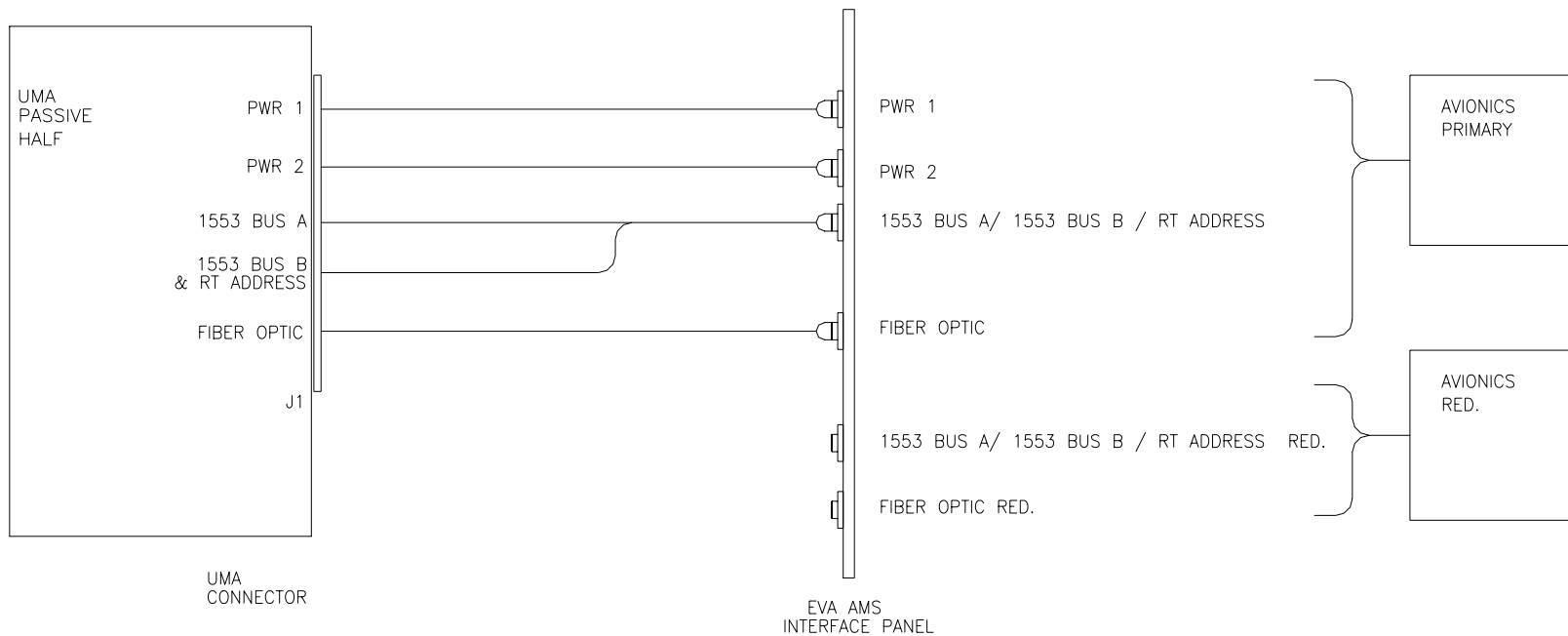


EVA Interface

- Allows for redundant avionics interfaces in contingency scenario
- First access test in NBL completed in March 2002, no mission specific NBL testing required
- Second NBL access test (with higher fidelity mockup) performed in November 2002
- Connectors will meet the mating/demating requirements identified in letter MA2-99-170
- No specific EVA training requirements



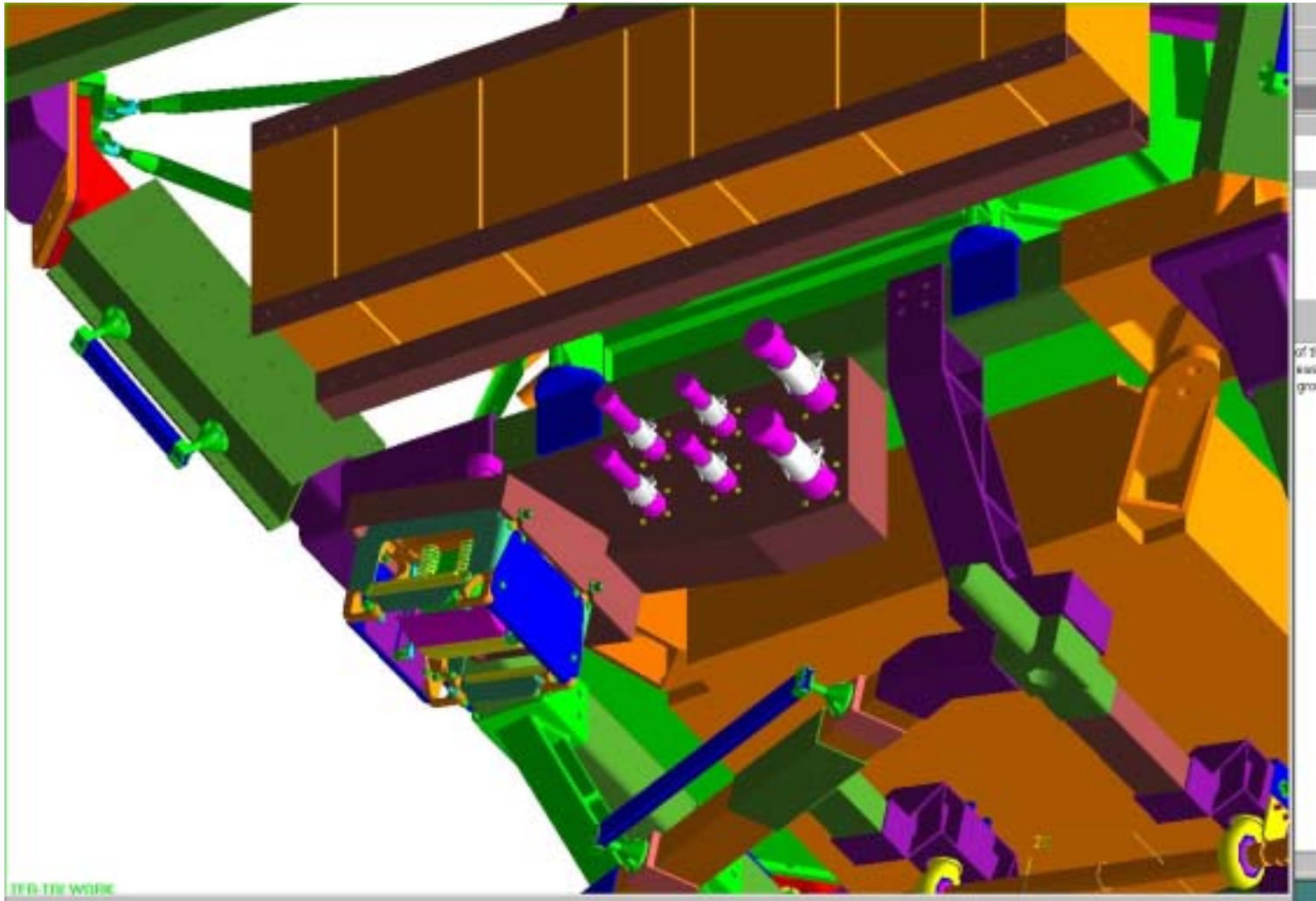
Passive UMA EVA Connector Layout



Hesham Hussein
2001.01.03

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Space Operations

EVA Connector Panel

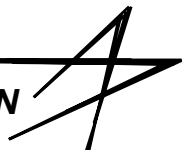


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Space Operations



Mission Abort

- In the event of an abort (e.g. RTLS, TAL, or any other return with AMS still in STS), power needs to be applied after landing to:
 - Monitor He tank pressure
 - Open Vent valve when He pressure exceeds 1 atm
 - Present calculations estimate the vent valve opening to be between 10 hours and 2 days, so power should be supplied approximately by Landing plus 5 hours
 - Not a safety concern, but rather a refurbishment concern (don't want to operate burst valves)

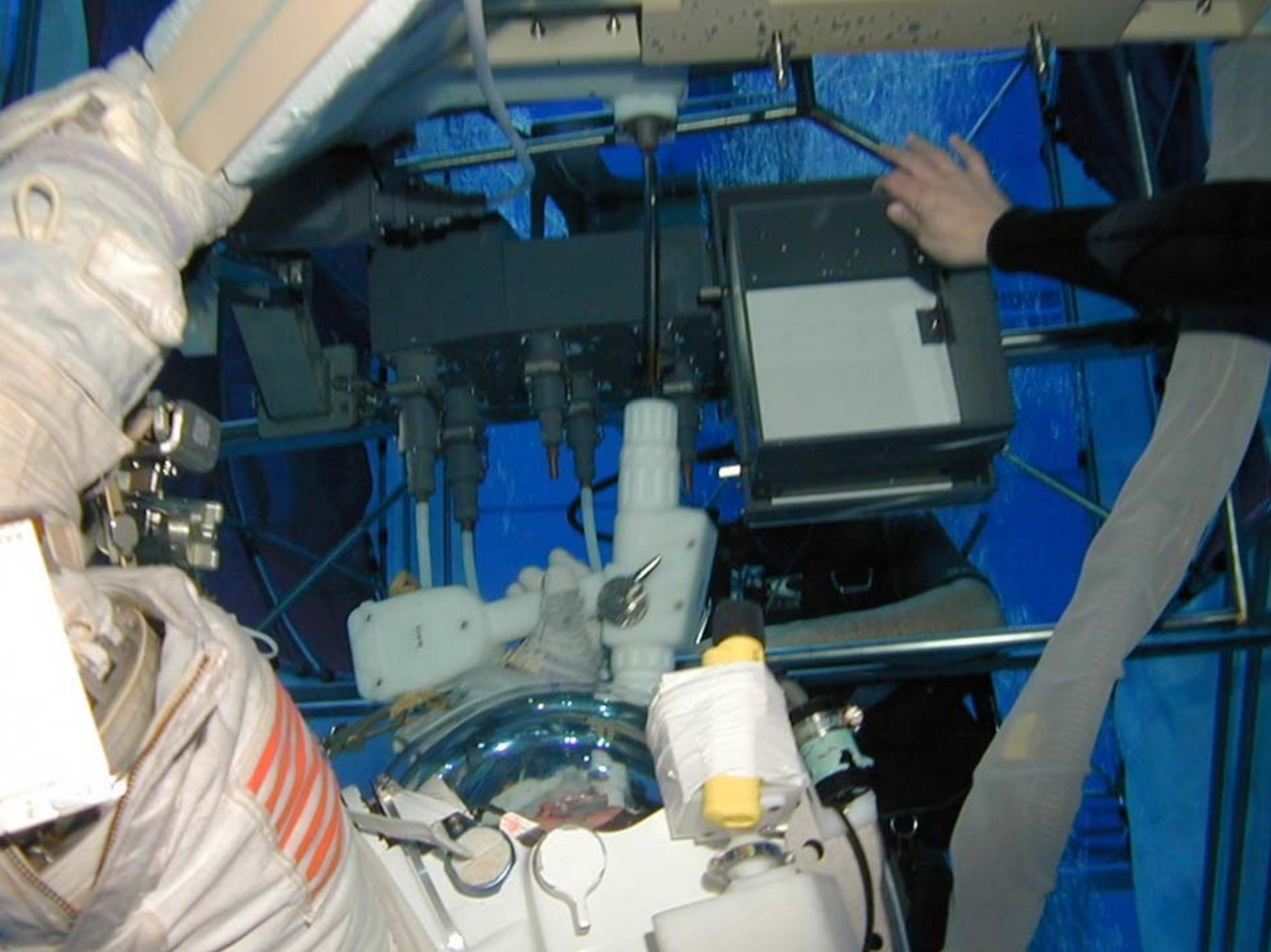


NBL Testing

- Testing to evaluate AMS Contingency EVA interfaces was performed November 12th thru 15th, 2002 (five crewmembers performed tasks)
- Testing included:
 - PVGF Contingency Release
 - PVGF Grapple Release
 - LEE Release
 - Capture Bar Contingency Release
 - Connector Panel Access/Evaluation
 - Passive Umbilical Mating Assembly (UMA) bolt access
 - And, crew translation path evaluation

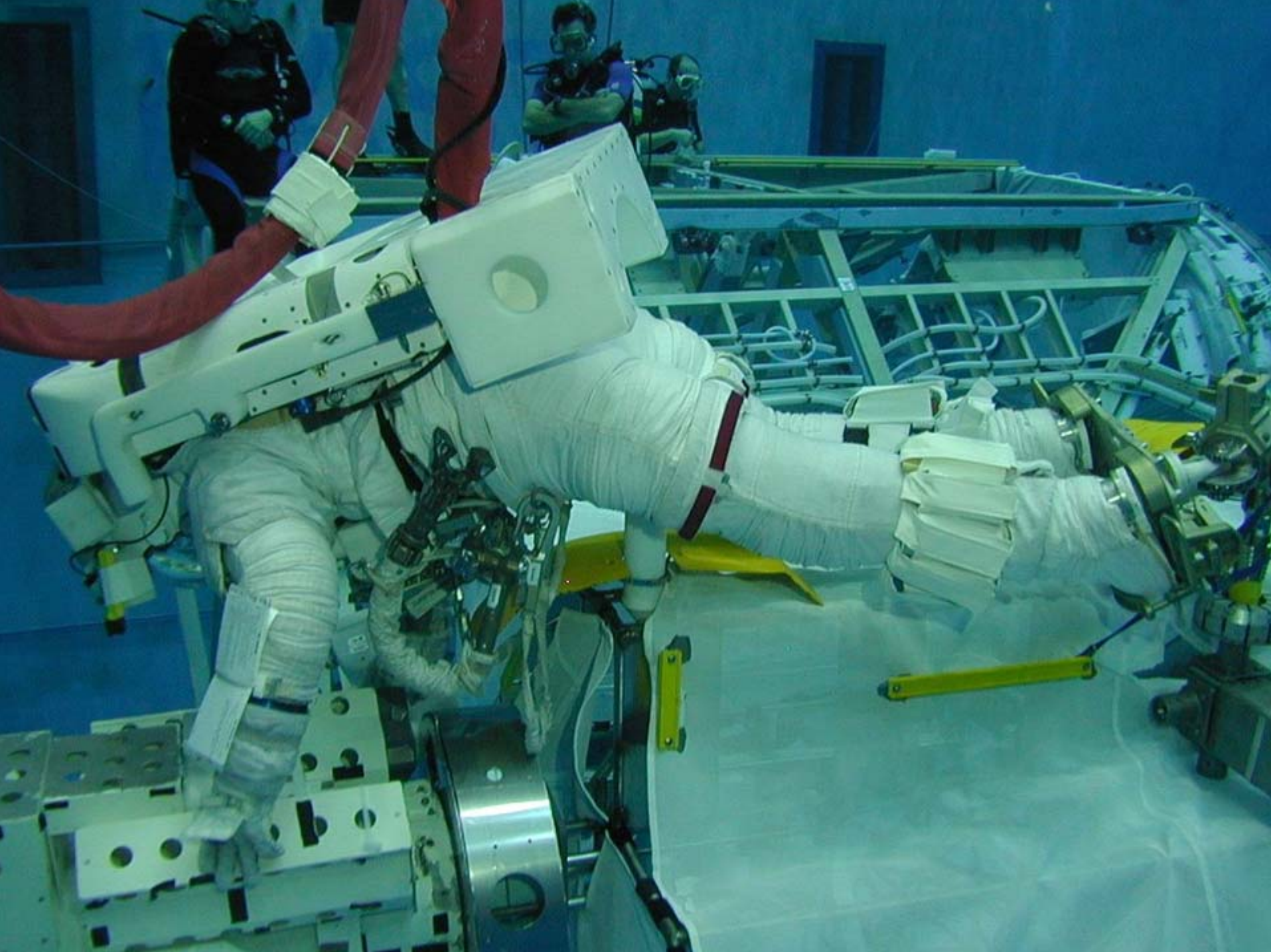


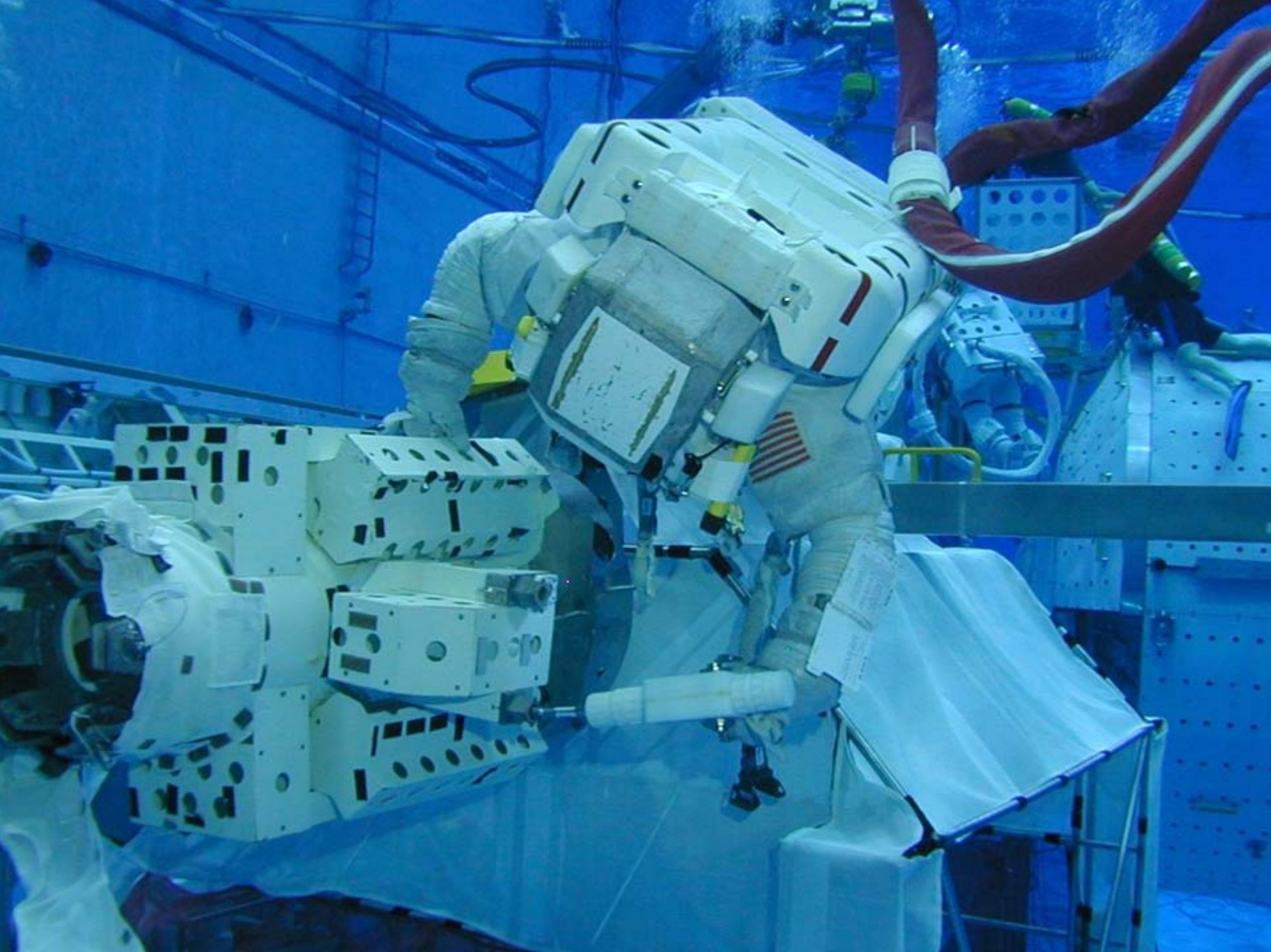












NBL Test Results

- All tested tasks were deemed “acceptable” as documented in Crew Consensus Report (reference letter CB-02-129)
- Only minor issues identified with
 - Labeling (to be validated from drawings)
 - Fit-checks (to be verified with flight hardware)
 - Connector clocking (verified by drawings)
- All issues resolved in the data-package (except fit-check verification)

